Behaviour of TiB_2-Coating on Graphitized Carbon Cathodes During Laboratory Electrolysis

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The TiB_2 TINOR coating has been applied on 14 different smelters throughout the world. The main ingredients of the TINOR coating are a slurry of TiB_2 in colloidal alumina which is brushed on carbon in several layers. The colloidal alumina is transformed into a solid binder by heating and aluminized. The coating has been steadily improved with respect to adherence to the carbon and between the successive TiB_2 layers and with respect to the wetting of liquid aluminium. This is accomplished by adding chemical modifiers to the coating. The present TINOR 2000^{TM} coating is typically a 1.1 mm crack-free coating.

The TiB_2 coating accomplishes wetting between liquid aluminium and the cathode and is expected to lead to the following improvements in aluminium electrolysis:

a) Slower and more controlled sodium penetration;
b) Improved cathode current distribution;
c) Lower cathode voltage drop;
d) Improved current efficiency;
e) Less sludge formation;
f) Increased resistance towards abrasion / corrosion.

The last point has become increasingly important for the modern high amperage cells that use graphitized cathodes. With the low electrical resistance of graphitized cathodes the current density will be higher at the block ends [1]. High current density combined with low abrasion resistance lead to life-determining excessive wear at the ends of the cathode blocks [2, 3].

Graphitized carbon materials were coated with alumina-bonded TiB_2 (TINOR). The coating thicknesses were 1.2/0.2, 0.45, 0.8 and 1.1 mm.

The baked coating before electrolysis adhered strongly to the graphitic substrate. Traction tests give breakage in the graphitized material rather than in the coating substrate interface.

The thin coating (< 0.5 mm) is far less effective than the thick coating. Partial surface oxidation during the start-up (under industrial conditions with insufficient protection by Al sheet), could lead to partial loss of coating thickness by dissolution of the binder matrix in cryolite (about 0.3 - 0.4 mm) before total aluminization occurred. However, a thin coating may be effective if oxidation during start-up can be avoided. In a prior work of a hanging cathode tests, it was shown that a thin coating worked well. The aluminizing was done by dipping the cathode in a molten aluminum bath without access to oxygen before placing it in the cell. There was no oxidation and therefore the effectiveness of the thin coating was observed.

The electrical resistance of the coating is low and stable as demonstrated especially for the 0.8 and 1.1 mm coating.

The standard 1.1 mm TINOR 2000 gave complete wetting and the coating is intact with only a 100 m layer of Al_4C_3 underneath. The formation of Al_4C_3 does not lead to delamination.

References

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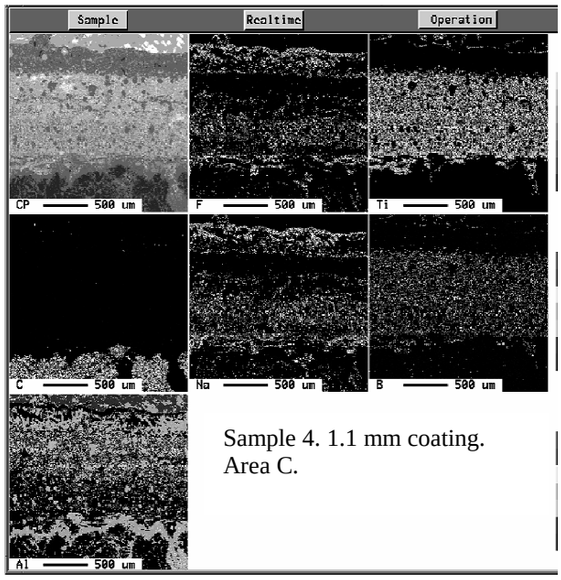

Sample 4. 1.1 mm coating. Area C.